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C3T TFB T201 T202 T203 T204 T226 T364 T542 T594
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(56) Documents cited
JP 550036987 A JP 540124298 A JP 540093301 A
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Applied Optics 24(24) 4489-92 (1985)

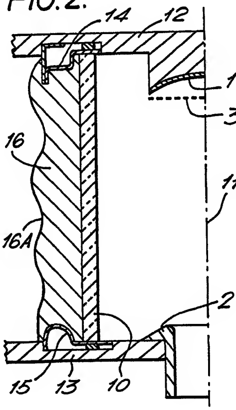
(58) Field of search
Online databases: CAS-ONLINE; WPI

(54) **RF radiation absorbing material**

(57) An RF radiation absorbing material able to hold off a 30 to 40KV voltage difference is formed by a silicone rubber loaded with ferrite particles.

This material can be used to reduce self oscillation in amplifiers. A preferred amplifier comprises cathode (1), anode (2) and grid (3) enclosed within a tubular ceramic envelope (10). The envelope (10) is covered with a layer (16) of silicon rubber loaded with ferrite.

FIG. 2.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG.1.

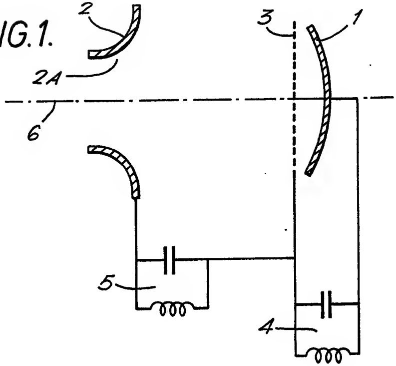
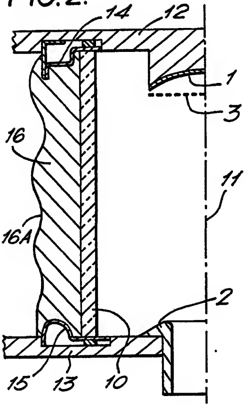


FIG.2.



RF Radiation Absorbing Material

This invention relates to a radiation absorbing material and the use of this material to stop self oscillation in an amplifier, and particularly in an inductive output tube amplifier.

An inductive output tube amplifier, hereafter referred to as an IOT, is shown schematically in Figure 1. This comprises a cathode 1 and an anode 2 separated by a grid 3, the anode 2 having a hole 2A passing through it.

In use a high DC voltage, typically of the order of 30 to 40 KV is established between the cathode 1 and anode 2 and an RF input signal is applied between the cathode 1 and grid 3. The cathode 1, anode 2 and grid 3 are symmetrically arranged about an axis 6. Electrons are emitted by the cathode 1 and their movement towards the anode 2 is controlled by the relative voltages of the cathode 1 and the grid 3. Thus an electron beam coaxial with the axis 6 and modulated by the RF signal applied between the cathode 1 and the grid 3 is generated between the cathode 1 and the anode 2, most of the electrons in this modulated electron beam, often referred to as a bunched electron beam, pass through

the hole 2A in the anode 2. This electron beam is then used to drive later stages in the amplifier.

The cathode 1 is linked to the grid 3 by a first resonant tuned circuit 4 while the cathode 2 is linked to the grid 3 by a second resonant tuned circuit 5. As is conventional the tuned circuits 4 and 5 are each represented by an inductance and a capacitance in parallel in Figure 1 although they will generally be far more complex than this in practice.

The first resonant tuned circuit includes variable components arranged so that by altering the value of the variable components its resonant frequency can be adjusted to the desired output frequency of the amplifier, the signal to be amplified is then coupled into this first resonant tuned circuit in order to apply it between the cathode 1 and the grid 3.

The second resonant tuned circuit 5 on the other hand is formed by the component parts of the amplifier and as a result resonates at a fixed frequency. RF baffles are provided to prevent interference between the first and second resonant tuned circuits 4 and 5 but it has been found that it is still possible under some conditions for RF

radiation emitted by the second resonant tuned circuit 5 formed between the anode 2 and grid 3 to pass through the baffles and be picked up by the first resonant tuned circuit 4. This results in an RF voltage at the resonating frequency of the second resonant tuned circuit appearing between the cathode 1 and grid 3 causing the electron beam to be modulated at this frequency. This is self oscillation and the unwanted signal at the resonant frequency of the second tuned circuit 5 blots out the signal it is desired to amplify and can generate high enough voltages to damage or disable the amplifier.

Self oscillation is generally a greater problem at higher operating frequencies and is often the limiting factor setting the maximum operating frequency of an IOT amplifier.

One way of reducing this problem would be to use an RF radiation absorbing material between the two resonant tuned circuits, but it was found that to achieve the best results such a material had to absorb RF radiation and be able to hold off the DC voltage between the anode and cathode.

This invention was intended to produce such a material and a method of using it to reduce self oscillation in an

amplifier.

This invention provides an RF radiation absorbing material used to hold off a DC voltage difference and comprising a silicone rubber loaded with ferrite particles.

This material has been used in the past as a RF radiation absorber but it has now been realised that it can also be used to hold off a very high DC voltage, of the order of 30-40KV.

In a second aspect this invention provides an amplifier including a cathode and an anode separated by a grid and enclosed within a ceramic envelope, where the ceramic envelope is surrounded by a layer of a silicon rubber loaded with ferrite particles.

An amplifier embodying the invention will now be described by way of example only with reference to the accompanying diagrammatic figures in which,

Figure 1 shows a part of an amplifier, and

Figure 2 shows a cross section through an amplifier employing the invention, similar parts having the same

reference numerals throughout.

Referring to figure 2 the IOT amplifier structure shown in Figure 1, comprising a cathode 1, anode 2 and grid 3 is enclosed within a tubular ceramic envelope 10. Only half of the structure is shown, it is rotationally symmetrical about the axis 11. The supports and feeds for the grid 3 are omitted for clarity, as is the cathode heater.

The ends of the cylindrical ceramic envelope 10 are closed by two conductive metal plates 12 and 13 and the interior of the envelope 10 is evacuated. A gas tight seal between the plates 12 and 13 and envelope 10 is provided by brazed conductive flanges 14 and 15 respectively.

The plate 12 is at the same voltage as the cathode 1 while the plate 13 is at the same voltage as the anode 2, as a result when the amplifier is operating a voltage difference of 30 to 40KV exists between the plates 12 and 13 and also between their associated flanges 14 and 15 respectively.

It has been realised that the RF radiation from the second tuned resonant circuit 5 which induces self

oscillation escapes the enclosure formed by the plates 12 and 13 and ceramic 10 by passing through the ceramic envelope 10.

It was decided that the best way to reduce this escape of RF radiation and so reduce the tendency to self oscillation would be to surround the ceramic envelope with a lossy material, however such a layer would have to contact the flanges 14 and 15 and so would have to hold off a 30 to 40KV DC voltage. No material was known to have the necessary properties to do this.

The escape of RF radiation is reduced by surrounding the cylindrical ceramic envelope 10 in a substantially cylindrical layer 16 of a silicon rubber loaded with ferrite particles.

A suitable ferrite loaded silicone rubber material is Eccosorb CF-S-4180 sold by Emerson and Cuming. This ferrite loaded silicon rubber material is a high loss material in the UHF and microwave ranges and it has been realised that it can also hold off very high DC voltages of the order of several tens of kilovolts.

The layer 16 is only substantially cylindrical because

its outer surface 16A bears a series of smooth ripples or undulations which extend around the circumference of the layer 16. Those ripples prevent dust deposition forming tracks across the outer surface 16A of the layer 16. Such dust tracks would be undesirable because they could provide a path for arcing across the surface 16A.

Although the amplifier section shown has been described as a part of an IOT amplifier similar structures are used as parts of other amplifier types such as klystrons and the invention is equally applicable to such amplifiers.

Instead of the circumferential ripples described the outer surface could have any other of the many known dust deposition reducing profiles or if dust deposition was not a problem in a particular application, could be a simple cylindrical surface.

CLAIMS

1. An RF radiation absorbing material used to hold off a DC voltage difference and comprising a silicone rubber loaded with ferrite particles.

2. A material as claimed in claim 1 used to hold off a DC voltage difference in the range 30 to 40KV.

3. An amplifier including a cathode and an anode separated by a grid and enclosed within a ceramic envelope, where the ceramic envelope is surrounded by a layer of a silicon rubber loaded with ferrite particles.

4. An amplifier as claimed in claim 3 where a DC voltage difference exists between the ends of the ceramic envelope and the DC voltage difference is held off by the layer of silicone rubber loaded with ferrite particles.

5. An amplifier as claimed in claim 4 where the DC voltage difference is in the range 30 to 40KV.

6. An amplifier as claimed in any of claims 3 to 5 where the amplifier is an inductive output tube amplifier.

7. An amplifier as claimed in any of claims 3 to 5 where the amplifier is a klystron.

8. An amplifier substantially as shown in or as described with reference to figure 2 of the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9119947.1

Relevant Technical fields

(i) UK Cl (Edition)

(ii) Int Cl (Edition)

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE : CAS-ONLINE; WPI

Search Examiner

MISS D DAVIES

Date of Search

20 NOVEMBER 1991

Documents considered relevant following a search in respect of claims 1-2

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	JP 2004871 A (Sharp KK) (WPI Acc. No 90 - 049601/07)	1,2
X	JP 55036987 A (Yokohana Rubber) (WPI Acc. No 80 - 30364C/17)	1,2
X	JP 54124298 A (T D K Electronics) (WPI Acc. No 79 - 90035B/50)	1,2
X	JP 54093301 A (T D K Electronics) (WPI Acc. No 79 - 65249B/36)	1,2
X	Applied Optics 24(24) 4489-92 (1985)	1,2

Category	Identity of document and relevant passages	Relevant to claim(s.

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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